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Reduction of Catheter-Associated Urinary Tract Infections Through a Nurse-Led Collaborative at a Rural Midwestern Hospital

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REDUCTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS
THROUGH A NURSE-LED COLLABORATIVE
AT A RURAL MIDWESTERN HOSPITAL

By

Natalie Pianetto Buck

SCHOLARLY PROJECT

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Northern Michigan University
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School of Nursing

July 2018

SIGNATURE APPROVAL FORM

REDUCTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS THROUGH A NURSE-LED COLLABORATIVE AT A RURAL MIDWESTERN HOSPITAL

This DNP Scholarly Project by Natalie Pianetto Buck is recommended for approval by the student's Faculty Chair, Committee, and Interim Associate Dean/Director in the School of Nursing

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ABSTRACT

REDUCTION OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS THROUGH A NURSE-LED COLLABORATIVE AT A RURAL MIDWESTERN HOSPITAL

By

Natalie Pianetto Buck

Catheter-associated urinary tract infections (CAUTIs) contribute to patient discomfort, complications, prolonged hospital stays, increased healthcare costs, and increased mortality (Agency for Healthcare Research and Quality [AHRQ], 2015). Despite the fact that these infections have proven to be preventable, CAUTI rates continue to exceed the national benchmark (Centers for Disease Control and Prevention, 2016a; Meddings et al., 2014). Evidence-based guidelines propose a bundle method is the most effective way to successfully reduce CAUTIs (AHRQ, 2015; Gould et al., 2017; Lo et al., 2014). The purpose of this research was to demonstrate whether a nurse-led collaborative, which bundled evidence-based interventions to reduce CAUTIs, was effective in reducing CAUTI rates at a rural Midwestern hospital. Additionally, nursing staff compliance with the bundled interventions following formal education was explored. A retrospective pretest-posttest design was utilized to review previously collected data related to CAUTI rates prior to and following implementation of a CAUTI bundle as well as nursing staff compliance with the interventions. CAUTI rates decreased from a mean of 1.63 to 0.67 per 1,000 catheter days. Additionally, there was a 5% reduction in catheter days. Nursing staff compliance increased steadily in the six months following staff education, with total compliance for all units exceeding 95%.

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NATALIE PIANETTO BUCK
July 25, 2018

DEDICATION

This Doctor of Nursing Practice scholarly project is dedicated to my support system – those who have believed in me, encouraged me, and pushed me to be the very best version of myself. Thank you to my parents, who emphasized the importance of education throughout my entire life. I would not be where I am today had it not been for my mom’s dedication and commitment to working with me from a very young age and unwavering support through each step in my educational journey. Thank you to my husband for dealing with my stress and time away from home as I worked to achieve this doctoral degree. Last but not least, my Gracie girl – thank you for bringing joy to my life that has far surpassed anything I ever imagined was possible. I wish you success beyond your wildest dreams, and will be here to believe in you, encourage you, and support you every step of the way!

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LIST OF ABBREVIATIONS

AHRQ	Agency for Healthcare Research and Quality
CAUTI	Catheter-Associated Urinary Tract Infection
CDC	Centers for Disease Control and Prevention
CLABSI	Central Line-Associated Bloodstream Infection
CMS	Centers for Medicare and Medicaid Services
DNP	Doctor of Nursing Practice
EMR	Electronic Medical Record
FIRM	Foley Insertion Removal Maintenance
HAI	Healthcare-Associated Infections
ICU	Intensive Care Unit
IHI	Institute for Healthcare Improvement
IMCU	Intermediate Care Unit
IRB	Institutional Review Board
MRSA	Methicillin-Resistant <i>Staphylococcus Aureus</i>
NHSN	National Healthcare Safety Network
SDU	Step-Down Unit

Chapter One

Introduction to the Problem

Background and Significance

Healthcare-associated infections. Healthcare-associated infections (HAIs) are infections acquired by patients while receiving medical or surgical treatment for an unrelated condition in a healthcare facility (Centers for Disease Control and Prevention [CDC], 2016a). Infections of significance that have been routinely monitored in recent years include central line-associated bloodstream infections, catheter-associated urinary tract infections (CAUTIs), multidrug-resistant infections (methicillin-resistant *Staphylococcus aureus* [MRSA] and *Clostridium difficile*), surgical site infections, and ventilator-associated pneumonia (CDC, 2016b). Reduction of HAIs is a priority patient safety issue identified by organizations such as the CDC, the Centers for Medicare and Medicaid Services (CMS), and the Department of Health and Human Services (CDC, 2016a; CMS, 2017; Office of Disease Prevention and Health Promotion, 2017). Additionally, The Joint Commission (2017) continues to include prevention of infections acquired in the healthcare setting as one of the National Patient Safety Goals. HAIs contribute to unnecessary antibiotic use, antibiotic resistance, prolonged hospital stays, increased morbidity and mortality, and are associated with significant healthcare costs (CDC, 2016c; World Health Organization, 2017).

While the burden of HAIs is known to be extensive, an accurate measurement of total incidence and cost has proven to be difficult. Studies published in the past 10 years estimate the annual cost of HAIs to range from 9.8 to 45 billion dollars (Scott, 2009; Zimlichman et al., 2013). This wide range is due to the variation in infection data that

has historically been collected, how it has been collected, and what has been reported. For instance, while some hospitals have reported any infection or need for antibiotics not present upon admission, other institutions have limited reporting to medical device-associated infections (such as CAUTIs, central line-associated bloodstream infections, and ventilator-associated pneumonia) (Magill et al., 2014). Additionally, Scott (2009) notes surveillance studies vary greatly in terms of the population of interest. For example, some studies included pediatric patients while others did not; and some were limited to specific areas of the hospital, such as intensive care units (ICU), while others included all areas of the hospital (Scott, 2009). According to a national surveillance study funded by the CDC, in 2002 there were an estimated 1.7 million HAIs (Klevens et al., 2007). In 2011, a multistate point-prevalence survey estimated the burden of HAIs to be significantly lower at 722,000 total annual infections with 75,000 associated deaths (Magill et al., 2014). More recently, a 2014 CDC report estimated that on any randomly selected day, one in 25 hospitalized patients had at least one HAI (CDC, 2016a).

With such variation in the reported incidence of HAIs, it became obvious that in order to accurately survey the burden and monitor effectiveness of efforts to reduce rates, a more standardized approach was warranted. Consequentially, in 2015, the CMS made changes to the guidelines for monitoring and reporting hospital-acquired infections (2017). Furthermore, in order to truly emphasize the importance of reducing HAIs and complying with the required reporting structures, hospitals falling within the lowest performing quartile nationally are fined with a 1% reduction in Medicare reimbursement the subsequent year (CMS, 2017). This potential financial loss has created a motivating

factor for hospitals to not only develop protocols aimed at decreasing HAIs, but to ensure required information is collected in an accurate and systematic manner.

As one change perpetuates another, the CDC's National Healthcare Safety Network (NHSN), which is the nation's most widely used healthcare surveillance system, also made updates to the way in which information is required to be reported by healthcare institutions (CDC, 2016b). With data related to HAIs being entered into the NHSN system in a consistent way, comparisons can more accurately be made and trends more easily monitored nationally, statewide, and locally for each individual healthcare facility (CDC, 2016b). As a result of these changes in HAI surveillance, it should become much more evident how effective hospital-developed programs actually are at reducing infections acquired in the hospital setting.

While there has been debate related to the accuracy of HAI rates, the CDC's 2016 annual progress report on HAIs presented data suggesting good improvement in the reduction of some specific infection types (CDC, 2016b). Between 2008 and 2014, there was a 50% reduction in central line-associated bloodstream infections (CDC, 2016b). Surgical site infections related to 10 selected procedures decreased by 17% between 2008 and 2014 (CDC, 2016b). Additionally, hospital-onset *Clostridium difficile* and MRSA bacteremia decreased by 8% and 13%, respectively, between 2011 and 2014 (CDC, 2016b). The one area where no improvement has been demonstrated is with the incidence of CAUTIs (CDC, 2016b).

CAUTI. In 2011, there were an estimated 93,300 urinary tract infections that occurred in acute care hospitals in the United States (CDC, 2017). The vast majority of these infections were healthcare-associated, caused by instrumentation of the urinary

tract, primarily with an indwelling urinary catheter (CDC, 2017). Because up to 25% of all hospitalized patients have an indwelling urinary catheter at some point during their hospital stay, and each day the catheter is in place a patient has a 3-7% increased risk for attaining a UTI, CAUTIs have the potential to negatively impact a significant number of individuals (Lo et al., 2014). Not only do CAUTIs lead to patient discomfort, but also prolong the hospital stay by an average of two to four days, raise healthcare costs, and increase mortality (AHRQ, 2015). Potential complications of CAUTIs are extensive, including prostatitis, epididymitis, orchitis, cystitis, pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis (CDC, 2017).

The estimated annual costs related to CAUTIs are between 350 and 450 million dollars (Scott, 2009). Because this appraisal dates back to 2009, and the incidence of CAUTIs have not improved in recent years, one could only ascertain that the cost would logically be much higher at the present date. What is most concerning, however, is the plethora of research documenting the highly preventable nature of CAUTIs and estimates that up to 70% of these infections are avoidable (AHRQ, 2015; Gould et al., 2017; Hooton et al., 2010; Lo et al., 2014; Meddings, Rogers, Macy, & Saint, 2010; Saint et al., 2016; Umscheid et al., 2011).

Statement of the Problem

Despite the fact that CAUTIs have proven to be preventable, CAUTI rates continue to exceed the national benchmark of 1.80 per 1,000 catheter days (CDC, 2016a; Meddings et al., 2014). Evidence-based guidelines specifically outlining measures for CAUTI prevention recommend a bundle method, or grouping of several proven

interventions, is the most effective way to reduce CAUTIs (AHRQ, 2015; Gould et al., 2017; Lo et al., 2014). Despite this, there remains a deficit in the research. There are limited follow-up studies documenting the implementation of the guidelines into practice. There is also no standardized bundle used across multiple studies. Furthermore, many of the studies that include a bundle method as a means for reducing CAUTIs are still in progress and lack outcome data (Giles et al., 2015). In order to support the bundling of interventions to reduce CAUTIs, further implementation of the associated research and guidelines to determine their effectiveness is warranted.

Statement of Purpose

The purpose of this research was to demonstrate whether a nurse-led collaborative, which bundled evidence-based interventions to reduce CAUTIs, was effective in reducing CAUTI rates at a rural Midwestern hospital. Additionally, nursing staff compliance with the bundled interventions following formal education was also explored.

This Doctor of Nursing Practice (DNP) scholarly project utilized a retrospective pretest-posttest design. For review of CAUTI rates, a convenience sample of all patients with an indwelling urinary catheter, in one of the designated inpatient units at a rural Midwestern hospital during a 26 month period, was utilized. Designated areas of the hospital included the ICU, intermediate care unit (IMCU), medical unit, cardiac unit, neurology/surgical/orthopedic unit, and physical rehabilitation unit. As CAUTI rates are calculated utilizing catheter days, instead of focusing on total patients, the sample was converted to a total of 18,577 catheter days for meaningful use. The Mann-Whitney *U* test was used to compare CAUTI rates before and after implementation of the bundled

interventions and staff education. For review of nursing staff compliance with the bundled interventions following formal education, a convenience sample of all available patients with an indwelling urinary catheter in place in one of the aforementioned inpatient units during the time of device rounds throughout a 14 month period was used. A total of 2,928 patient and/or electronic medical record (EMR) observations were made and all were included in the study. Linear regression was used to explore nursing staff compliance with the bundled interventions over time.

Introduction of Theoretical Framework

To achieve a reduction in CAUTI rates and gain compliance with a bundle of interventions to prevent CAUTIs, nursing staff must understand the need for change in care, implement the change, and maintain the change. Lewin's change theory (1947) served as an appropriate theoretical framework to guide this process. Generally speaking, change theories explore the method for effectively implementing and maintaining a change. Lewin's specific theory involves the following three stages of change: unfreezing, moving (or changing), and refreezing (1947). During the unfreezing stage, a problem is identified and need for change is recognized (Lewin, 1947; Shirey, 2013). The moving stage involves implementation of the change and requires support from all who are involved (Lewin, 1947; Shirey, 2013). The final stage, refreezing, sets the change as a new habit within the environment (Lewin, 1947; Shirey, 2013). Utilization of Lewin's change theory as a means for compliance with implementation of interventions to reduce CAUTI rates will be explored further in the next chapter.

Chapter Two

Literature Review

CAUTI: Guidelines

Numerous guides, guidelines, and toolkits have been published related to the prevention of CAUTIs (AHRQ, 2015; Association for Professionals in Infection Control and Epidemiology, Inc., 2014; Gould et al., 2017; Hooton et al., 2010; Institute for Healthcare Improvement [IHI], 2011; Lo et al., 2014). Organizations such as the AHRQ, Association for Professionals in Infection Control and Epidemiology, CDC, Infectious Diseases Society of America, IHI, and Society for Healthcare Epidemiology of America have systematically reviewed the literature, utilizing evidence-based research to develop such guidelines, which can then be implemented by healthcare organizations. According to the CDC's Healthcare Infection Control Practices Advisory Committee, the guidelines are intended to be utilized by "infection prevention staff, healthcare epidemiologists, healthcare administrators, nurses, other healthcare providers, and persons responsible for developing, implementing, and evaluating infection prevention and control programs for healthcare settings across the continuum of care" (Gould et al., 2017, p. 8). Additionally, these guidelines can and have been used by organizations to create "more detailed implementation guidance for prevention of CAUTI" (Gould et al., 2017, p. 8). While the format of each guideline varies slightly, the information presented is resoundingly similar. The following three specific areas have been identified as foci in the development of programs to reduce CAUTIs:

1. appropriate catheter use,
2. proper technique for catheter insertion and maintenance, and

3. prompt catheter removal (AHRQ, 2015; Association for Professionals in Infection Control and Epidemiology, Inc., 2014; Gould et al., 2017; Hooton et al., 2010; Lo et al., 2014).

Appropriate catheter use. Appropriate indications for indwelling urinary catheter use have been identified in the aforementioned guidelines, where the CDC's Healthcare Infection Control Practices Advisory Committee's *Guidelines for Prevention of Catheter-Associated Urinary Tract Infections* serves as the gold standard (AHRQ, 2015; Gould et al., 2010). These indications were further refined and defined to increase ease of understanding and implementation in *The Ann Arbor Criteria for Appropriate Urinary Catheter Use in Hospitalized Medical Patients* (Meddings et al., 2015). Additionally, the CDC's guidelines which were initially written in 2009, have been updated regularly, with the most recent revisions published in 2017 (Gould et al., 2017). The updated Ann Arbor and CDC guidelines were composed by a group of content professionals who reviewed the current literature and utilized an expert panel to ascertain whether the benefits of urinary catheterization outweigh the potential harms (AHRQ, 2015; Gould et al., 2017; Meddings et al., 2015). As a result, the following six indications for indwelling urinary catheter use were identified and defined:

1. acute urinary retention or bladder outlet obstruction;
2. need for accurate measurement of urine output in critically ill patients;
3. perioperative use in selected surgeries (such as prolonged surgeries, when a patient will require large-volume infusions or diuretics during surgery, when there is need for intraoperative urinary output monitoring, or for urologic surgeries);

4. assistance with healing of stage III or IV perineal and sacral wounds in incontinent patients;
5. during the end-of-life period (such as in hospice, comfort, or palliative care); and
6. required immobilization for trauma or surgery (such as unstable spine fractures, pelvic fractures, hip fractures, or other unstable traumatic injuries) (Gould et al., 2017; Meddings et al., 2015).

The Ann Arbor Criteria expanded upon these indications to also include indwelling catheterization appropriation for the following four special circumstances:

1. 24-hour collection of a urine sample needed for diagnostic testing when all other urine collection strategies are not possible;
2. severe acute pain when the need for reduced movement is required (such as in the case of a patient with acute unrepaired hip fracture);
3. clinical conditions when intermittent straight catheterization would otherwise be appropriate but placement by an experienced nurse or physician is challenging; and
4. when non-indwelling strategies to empty the bladder remain inadequate (Meddings et al., 2015).

Additionally, the guidelines provide examples of common inappropriate catheter uses including the following:

1. a substitute for nursing care of a patient with incontinence,
2. a method of obtaining urine for testing or culture when a patient can otherwise void voluntarily, and

3. prolonged postoperative duration without a designated suitable indication
(such as structural repair of the urethra or prolonged epidural anesthesia)
(Gould et al., 2017).

Furthermore, when considering appropriate urinary catheterization, alternatives should be used whenever possible; external catheters and intermittent catheterization are preferred over indwelling catheterization when these options are feasible (Gould et al., 2017).

Proper technique for catheter insertion and maintenance. Review of available literature reveals numerous techniques associated with the catheter insertion process necessary to reduce the risk of CAUTIs. Hand hygiene should always be performed immediately before catheter insertion and manipulation of the catheter or entry site (Gould et al., 2017). Only properly trained staff should insert and manage catheters (Gould et al., 2017). Staff should receive formal education along with competency testing upon hire and annually so that CAUTI prevention interventions become a standard of care (AHRQ, 2015). When inserting catheters, aseptic technique and sterile equipment is required, followed by securement of the catheter to prevent movement or urethral traction (Gould et al., 2017).

There is also a variety of researched techniques related to catheter maintenance proven to reduce the risk of CAUTIs. After a catheter is inserted, a closed drainage system should always be maintained (Gould et al., 2017). If a break in the system or leakage occurs, the catheter as well as the collection system should be replaced (Gould et al., 2017). When possible and available, systems that have the catheter connected to the drainage tubing with a sealed junction should be utilized (Gould et al., 2017).

Unobstructed flow of urine must be maintained at all times. This involves keeping the

catheter and drainage tubing free from dependent loops and kinks and keeping the collection bag below the level of the bladder to prevent urine stasis and backflow (AHRQ, 2015; Gould et al., 2017). The urine collection bag should be emptied each shift, before any transfer, and as needed, while using a clean collection container for each patient (AHRQ, 2015; Gould et al., 2017). Finally, hands should be washed and gloves applied prior to manipulation of the catheter (AHRQ, 2015; Gould et al., 2017).

Furthermore, included in the guidelines is a listing of unnecessary or inappropriate catheter maintenance practices that lack supporting evidence or have proven to be ineffective. For example, the use of antiseptic-release cartridges in the drain port, cleansing the periurethral area with antiseptics while the catheter is in place, and use of urinary antiseptics or prophylactic systemic antimicrobials are not supported interventions (Gould et al., 2017). Additionally, changing catheters or drainage bags at regular intervals or routine bladder irrigation is not recommended (Gould et al., 2017). Rather, the catheters and bags should be changed if a CAUTI is confirmed or if there is an obstruction, a break in the system, or leakage of urine from the system (AHRQ, 2015). Bladder irrigation should be reserved for specific circumstances, including following genitourinary surgery where bleeding is likely and clots could obstruct the indwelling catheter or after an obstruction to urine flow has occurred (AHRQ, 2015).

Prompt catheter removal. Because the risk for CAUTI increases each day an indwelling urinary catheter remains in place, it is essential an assessment of ongoing need is performed at a minimum of every 24 hours (AHRQ, 2015; Gould et al., 2017). Patients not meeting an approved indication for appropriate catheter use should have the catheter discontinued (AHRQ, 2015; Gould et al., 2017). One method to expedite this

process is through the use of a nurse-led catheter removal protocol, which gives nurses decision making authority to discontinue indwelling catheters no longer meeting criteria for appropriate use (AHRQ, 2015).

CAUTI Research: The Bladder Bundle

A comprehensive review of the literature related to CAUTI prevention revealed a variety of research exploring how the guidelines for appropriate catheter use, proper technique for catheter insertion and maintenance, and prompt catheter removal have been implemented in practice. As previously discussed, experts suggest grouping interventions into a bladder bundle. According to the IHI, a bundle is “a collection of processes needed to effectively care for patients undergoing particular treatments with inherent risks,” such as the use of indwelling urinary catheters (n.d., para. 2). Utilization of a bladder bundle was conceptualized in 2007 by the Michigan Health and Hospital Association Keystone Center for Patient Safety and Quality through a statewide initiative related to HAI prevention (Saint et al., 2009; Saint et al., 2013). Modeled after successful central line-associated bloodstream infection prevention bundles, the bladder bundle focuses on implementation of a series of evidence-based strategies to decrease the risk of CAUTIs through elimination of unwarranted catheter use. Interestingly, there is no standardized bladder bundle with a specific grouping of CAUTI reduction interventions through the Keystone Bladder Bundle or elsewhere in the literature. Instead, experts recommend each healthcare facility customize a bundle of interventions based on the CAUTI prevention strategies that are already in place and determine which interventions may need to be added due to unique features of the institution (Saint et al., 2009). That being said, there are a few recommended interventions that should be included in every

bladder bundle. Of particular importance is daily patient rounds to assess for the presence of a catheter, review of the medical record to identify documented ongoing catheter need meeting an acceptable indication for use, proper technique for insertion and maintenance of the catheter, and a nurse-led catheter discontinuation protocol (Saint et al., 2009; Saint et al., 2013).

Giles et al. (2015) are in the process of reviewing the effectiveness of a bladder bundle that utilizes the acronym NO CAUTI to identify the components of the bundle. Staff education and associated CAUTI prevention interventions in the NO CAUTI bundle focus on the following:

1. need for catheter assessed;
2. obtain patient consent and offer education;
3. competency – must be documented for any individual who inserts indwelling urinary catheters;
4. asepsis – must be maintained during insertion and maintenance of catheters;
5. unobstructed flow – ensure no kinks or loops, catheter securement, and bag is located below the level of the bladder and off the floor;
6. timely catheter removal – facilitated by a nurse-led removal protocol; and
7. infection risk – collect urine specimen only when clinically indicated (Giles et al., 2015).

Another team created a bundled protocol called Foley Insertion Removal Maintenance (FIRM) (Gokula et al., 2012). The bundle components included adding a checklist for appropriate catheter indications to the urinary catheter insertion order set as well as a checklist to assist in guiding the orders for catheter maintenance and removal

(Gokula et al., 2012). The bundle was effective in reducing CAUTIs from 2.21 per 1,000 catheter-days to 0.435 per 1,000 catheter-days (Gokula et al., 2012). Therefore, the team was able to meet the national CAUTI benchmark of 1.80 per 1,000 catheter-days.

Marra et al. (2011) implemented the IHI's bladder bundle for all ICU and step-down unit (SDU) patients in a program called UC Bundle-Getting to Zero. The bundle consisted of the creation of an indwelling urinary catheter insertion cart, hand hygiene, chlorhexidine skin and meatal antisepsis, sterile field and sterile gloves, limit of one attempt at insertion allowed for each catheter, adequate balloon inflation, and daily review of the need for an indwelling urinary catheter with prompt removal if no longer indicated (Marra et al., 2011). The authors report a statistically significant reduction in CAUTI after implementation of the bladder bundle from 7.6 per 1,000 catheter-days to 5.0 per 1,000 catheter-days in the ICU and from 15.3 per 1,000 catheter-days to 12.9 per 1,000 catheter-days in the SDUs (Marra et al., 2011). Despite the improvement in CAUTI rates, this program was not yet able to meet the national benchmark of 1.8 per 1,000 catheter-days.

In an attempt to reduce CAUTIs in a progressive care unit, Carr, Lacambra, Naessens, Monteau, and Park utilized a bundle of interventions represented by the ABCDE mnemonic (2017). The ABCDE mnemonic for CAUTI prevention stands for

1. aseptic technique,
2. bladder ultrasound,
3. condom catheter,
4. do not use unless clinically necessary, and
5. early removal (Carr et al., 2017).

A CAUTI prevention form containing this mnemonic and space to identify the date of and reason for insertion was placed in each patient's room upon insertion of an indwelling urinary catheter (Carr et al., 2017). The form included a spot to document catheter care, provider awareness of the catheter, and implementation of all interventions including hand hygiene, monitoring for kinks in the catheter and tubing, securing the catheter to the leg, maintaining the seal between the catheter and the leg bag, and keeping the catheter below the level of the bladder but still off the floor (Carr et al., 2017). Results of the research demonstrated a 38% reduction in catheter-days as well as reduction in CAUTIs from 5.08 per 1,000 catheter days to zero CAUTIs during the 22 month period following implementation of the bundle (Carr et al., 2017).

In summary, there remains no national standard indicating a specific combination of bundled CAUTI prevention interventions. However, researchers have documented the effectiveness of bundling multiple evidence-based CAUTI prevention strategies in significantly reducing CAUTI rates (AHRQ, 2015; Association for Professionals in Infection Control and Epidemiology, Inc., 2014; Carr et al., 2017; Gokula et al., 2012; Gould et al., 2017; Hooton et al., 2010; Lo et al., 2014; Meddings et al., 2014; Saint et al., 2009; Saint et al., 2013). Selection of appropriate interventions should be based upon the unique features of a healthcare institution, its staff, the population it serves, and the current standards of care.

Theoretical Framework

Lewin's change theory (1947) was utilized to assist the hospital in implementation of a bundle of interventions aimed at reducing CAUTIs. The theory's three stages of unfreezing, moving or changing, and refreezing were useful in executing

an organizational change and promoting staff compliance. In the first stage of Lewin's change theory (1947), the need for change must be identified. For example, CAUTI rates exceeding the national benchmark was an indication a change must occur. Staff presumed to be impacted by the change must be made aware of the reason for the change. In this case, a discrepancy existed between the desired state, or CAUTI rates below the national benchmark, and the current state, or CAUTI rates above the national benchmark (Shirey, 2013). Because nursing staff were the individuals most directly involved in implementing the bundled interventions, it was essential they were part of the change process. To best prepare individuals for the next stage in the theory, discussion of both the need and plan for a change should occur before the change is implemented.

The second stage of Lewin's theory, the moving or changing stage, involves executing the change (1947). In this case, the change required nursing staff to implement a bundle of interventions to reduce CAUTI. For successful integration of the interventions, it was essential the staff were adequately educated on each individual intervention along with its purpose (Shirey, 2013). There is greater assurance for staff buy-in if the smaller goals as well as the overall desired outcome are made abundantly clear (Shirey, 2013). In this instance, the desired outcome was to meet or exceed the national benchmark for CAUTI rates and the staff goals were to demonstrate a desirable level of compliance in performing the bundled interventions, as determined by the institution.

The third, and final, stage of Lewin's change theory (1947) is the refreezing stage. In this stage, the change becomes a standard of care and develops permanency within the institution (Lewin, 1947). The goal is for nursing staff to be comfortable with the change

and integrate it into the institution's culture so that it becomes routine practice (Shirey, 2013). This stage was evaluated through review of staff compliance with interventions to reduce CAUTIs over an extended period of time following introduction of the change.

Chapter Three

Methods

Purpose

The purpose of this research was to demonstrate whether a nurse-led collaborative, which bundled evidence-based interventions to reduce CAUTIs, was effective in reducing CAUTI rates at a rural Midwestern hospital. Additionally, nursing staff compliance with the bundled interventions following formal education was also explored.

Project Approval

Institutional Review Board (IRB) approval by a rural Midwestern hospital's IRB was obtained on March 14, 2018 prior to implementation of this DNP scholarly project (See Appendix B). As data was preexisting and no patient-identifying information was linked to the data, there was no need for consent to be obtained from each participant. Additionally, university IRB approval was not required as participant consent was not needed for this project (See Appendix C).

Sample

Sample data was pre-existing with inclusion and exclusion criteria established by the hospital's Infection Preventionist at the time data collection took place. For review of CAUTI rates, a convenience sample of all patients with an indwelling urinary catheter, in one of the designated inpatient units at a rural Midwestern hospital between the dates of August 1, 2015 and December 2, 2017, was utilized. Designated areas of the hospital included the ICU, IMCU, medical unit, cardiac unit, neurology/surgical/orthopedic unit, and physical rehabilitation unit. No patient was knowingly excluded. Because CAUTI

rates are calculated utilizing catheter days, instead of focusing on total patients, the sample was converted to a total of 18,577 catheter days for meaningful use. All catheter days were utilized for the purpose of this research, so the entire patient population in the aforementioned units of the hospital was included.

For review of nursing staff compliance with the bundled interventions following formal education, a convenience sample was used and included all available patients with an indwelling urinary catheter in place on one of the aforementioned inpatient units during the time of device rounds between August 1, 2016 and December 31, 2017. Device rounds were completed during the day shift or first portion of the evening shift following a standardized schedule. Any patient with an indwelling urinary catheter in the ICU and IMCU was rounded on every Monday, Wednesday, and Friday. Any patient with an indwelling urinary catheter on the medical unit, cardiac unit, surgical/neurological/orthopedic unit, and the physical rehabilitation unit was rounded on every Tuesday and Thursday. A total of 2,928 patient and/or EMR observations were made and all of these observations were included in the study. While this researcher did not exclude any available data from the study, it is important to note that the rounding schedule may have prevented some of the population from being included. For example, subjects were excluded if they were not available at the time device rounds were completed. This occurred if they were off the unit for a procedure or in the rare case if they were involved in a procedure on the unit. In these instances, while direct patient observation was not possible, EMR review was still completed.

Compliance with the bundled CAUTI prevention interventions involved participation from registered Nurses, Licensed Practical Nurses, and Care Aides. While

specific staff were not identified or directly observed, nursing staff may have been included if they were involved in the care of a patient with an indwelling catheter on one of the designated units, particularly when device rounds were completed. There were no exclusion criteria.

Design, Procedures, and Measures

This Doctor of Nursing Practice (DNP) scholarly project utilized a retrospective pretest-posttest to compare CAUTI rates as well as nursing staff compliance with a bundle of interventions prior to and following introduction of the interventions during formal education. A series of email, phone, and in-person communication occurred between the author and the hospital's Infection Preventionist prior to the start of and throughout the DNP scholarly project. Interviews were also conducted with the hospital's Clinical Educators to gain a better perspective on the history of the CAUTI Collaborative. Because of the retrospective approach, it was important to have an understanding of what took place at the hospital prior before the inception of this research.

Prior to this research. The need for a change in practice related to specific preventable harms in the hospital setting was initially identified by the hospital's Infection Preventionist in early 2016. Standardized care for the prevention of CAUTIs, central line-associated bloodstream infections, and ventilator-associated pneumonia was lacking. Upon review of data related to the hospital's infection rates, it was determined there was room for improvement accompanied by a desire to surpass the national benchmark, instead of simply meeting it.

Conception of the CAUTI collaborative began with the Infection Preventionist's recommendations for quality improvement. She formed a team consisting of Nurse Managers, Nurse Directors, Clinical Educators, the Director of Nursing, the Chief Nursing Officer, and the Director of Quality. Additionally, the team received input from the Hospitalists, Intensivists, and the Chief Medical Officer. A review of current literature related to CAUTI prevention was conducted and 10 interventions were selected based on evidence-based guidelines from the CDC and IHI (Gould et al., 2010; IHI, 2011). The selected interventions included the following:

1. urinary drainage bag remains off the floor,
2. urinary drainage bag is positioned below the level of the patient's urinary bladder,
3. tubing is kept free from loops and kinks,
4. seal between the indwelling urinary catheter and drainage tubing remains intact,
5. indwelling urinary catheter is secured to the leg with a securement device,
6. indwelling urinary catheter care is completed daily,
7. perineal care is performed daily,
8. indwelling urinary catheter assessment is documented every shift,
9. ongoing need for the indwelling urinary catheter is documented daily, and
10. CAUTI prevention education is printed and provided to the patient within 24 hours of catheter insertion (Appendix A).

The CAUTI prevention education handout for patients comes from a patient education program built into the hospital's EMR called CareNotes®, ©IBM Watson Health

(Catheter-associated urinary tract infection, 2018). The exact same information is available from the CDC website and can be found in Appendix A. Included on the handout is a description of a CAUTI, description of a urinary catheter, causes of a CAUTI, symptoms of a CAUTI, common strategies used by hospitals and patients to prevent CAUTIs, and post-hospitalization considerations (CDC, n.d.).

After selecting the bundle of CAUTI-reducing interventions, a plan for data collection through device rounds was established. This plan allowed time for baseline data to be collected prior to implementation of the practice changes and for monitoring progress thereafter. Additionally, the team began working on updating hospital policies related to indwelling urinary catheters to ensure consistency with the bundled interventions. The Clinical Educators reached out to faculty at a local school of nursing for assistance in the development of educational materials for the nursing staff. This author served as the lead faculty for this task and created the poster used for staff education (See Appendix D). Concurrently, the Clinical Educators and other members of the CAUTI collaborative team created a plan for educating nursing staff on the quality improvement initiatives.

Education was provided to all nursing staff, including Registered Nurses, Licensed Practical Nurses, and nursing Care Aides during a mandatory Harms Prevention training event. The purpose of this formal staff education was to present information on preventable harms being addressed through various quality improvement projects in the hospital. Educational stations were created for common patient harms including falls, central line-associated blood stream infections, surgical site infections, *Clostridium difficile*, sepsis, venous thromboembolism, and CAUTIs. Staff had the option to attend

one of the sessions that took place on four separate dates between the beginning of August 2016 and beginning of December 2016. Information on the CAUTI prevention bundle was presented to small groups through the poster and a 10-15 minute verbal presentation, which was completed by the author or another trained member of the nursing faculty. Nursing staff education focused on appropriate catheter use, proper technique for catheter insertion and maintenance, and prompt catheter removal. Information on the selected bundle of interventions aimed at reducing the risk of CAUTIs was highlighted. Staff were shown tables outlining baseline data related to compliance with the interventions. This data was broken down for each of the designated areas of the hospital as well as in a summary table with all areas combined. The process of device rounds was explained to the staff so they were aware of how each of the bundled interventions would be monitored.

Device rounds were completed by the hospital's Infection Preventionist or a single trained auditor and involved an assessment of every patient with an indwelling urinary catheter as well as a review of each patient's EMR. Rounding was conducted on a regular schedule between August 1, 2016 and December 31, 2017, during the day shift or first portion of the evening shift. Any patient with an indwelling urinary catheter in the ICU and IMCU was rounded on every Monday, Wednesday, and Friday. Any patient with an indwelling urinary catheter on the medical unit, cardiac unit, surgical/neurological/orthopedic unit, and the physical rehabilitation unit was rounded on every Tuesday and Thursday.

A standardized paper form titled UPHSM Indwelling Device Rounding Tool was developed by the Infection Preventionist and used to collect data on each patient with an

indwelling urinary catheter in place during device rounds (See Appendix E). This data collection instrument had not previously been utilized, and therefore had not been tested for reliability or validity. The form contained a place to document the date and room number so the data could be compiled and organized according to date and unit. The form also had a place to record the patient's last name, account number, admission date, who provided the auditor with permission to enter the patient's room, and reason given if the auditor was asked to not enter the patient's room.

While assessing the patient with an indwelling urinary catheter, compliance with the following was assessed and documented on the form:

1. urinary drainage bag remains off the floor,
2. urinary drainage bag is positioned below the level of the patient's urinary bladder,
3. tubing is kept free from loops and kinks,
4. seal between the indwelling urinary catheter and drainage tubing remains intact, and
5. indwelling urinary catheter is secured to the leg with a securement device.

While auditing the EMR of the patient with an indwelling urinary catheter, compliance for the following was assessed and documented on the form:

1. indwelling urinary catheter care is completed daily,
2. perineal care is performed daily,
3. indwelling urinary catheter assessment is documented every shift,
4. ongoing need for the indwelling urinary catheter is documented daily, and

5. CAUTI prevention education is printed and provided to the patient within 24 hours of catheter insertion.

Using the standardized paper form, compliance was marked as met (yes), not met (no), or not applicable (N/A). There were a few reasons why one of the interventions may not have been applicable. For instance, if an indwelling urinary catheter was in place for less than 24 hours, some of the daily tasks such as catheter care and perineal care may not have needed to be completed yet. Despite not being completed, there was not a lack of compliance, so the item was marked as not applicable. Similarly, CAUTI prevention education was required within 24 hours of catheter insertion. If that 24-hour mark had not been reached, the education may not have been completed yet. As previously discussed, there were times a patient may have not been available for assessment. In these instances, when compliance could not be assessed through direct patient observation, a review of the EMR was completed.

After device rounds each day, the paper forms were brought to the locked office of the Infection Preventionist and placed in a labeled folder in a locked cabinet. The Infection Preventionist then entered the data into an Excel spreadsheet on a regular basis and saved the paper forms in a separate locked file. The Excel spreadsheet did not include any identifying patient or nurse information. Each row on the spreadsheet contained the data from a single patient assessment during device rounds. Recorded was the date, unit, and whether compliance was met, not met, or not applicable for each of the 10 aforementioned interventions.

Retrospective review of the data. After IRB approval, this author was provided with access to the hospital's monthly CAUTI rates and the Excel spreadsheet with data

related to nursing staff compliance with the bundled interventions. Monthly CAUTI rates during the time period of October 1, 2015 to November 30, 2017 were reviewed.

Baseline data prior to the CAUTI collaborative was obtained from the first year, October 1, 2015 to September 30, 2016. Introduction of the CAUTI collaborative and bundled interventions, including formal nursing staff education, began October 2016 through the start of December 2016. Post-intervention data was obtained from the second year, December 1, 2016 to November 30, 2017, and compared to data from the first year.

In addition to the review of CAUTI rates, data on staff compliance with the designated bundle of interventions to reduce CAUTIs was examined. Baseline compliance rates, prior to formal staff education, came from data collected between August 1, 2016 and October 1, 2016. During the period of October 2, 2016 through December 2, 2016, nursing staff were educated on the CAUTI bundle. Post-education data was reviewed for the periods of December 3, 2016 through December 2, 2017.

Data Analysis

The Mann-Whitney U was used to compare CAUTI rates before and after the intervention period using R Statistical Computing and Graphics Software, version 3.4.4. Nursing staff compliance with the bundled CAUTI interventions was explored using linear regression. All printed research materials and documents are being kept in a locked file cabinet in a private, locked office. All electronic data is being stored on a password-protected computer. After seven years, all of these materials and data will be destroyed.

Chapter Four

Results

The purpose of this retrospective research was to demonstrate whether a nurse-led collaborative, which bundled 10 evidence-based interventions to reduce CAUTIs, was effective in reducing CAUTI rates at a rural Midwestern hospital. Additionally, nursing staff compliance with the bundled interventions prior to and following formal education was explored. This chapter presents the results of this study and discusses how they relate and compare to other research related to this topic. Strengths as well as limitations are examined and recommendations are made for future research.

Sample Demographics

The study utilized patients at a 309-bed tertiary care hospital designated as a Level 2 Trauma Center located in the rural Midwestern United States. While specific patient demographics were not attached to the data used for this research, it is known they all had an indwelling urinary catheter in place and were inpatients on one of the aforementioned units. Patients were more than likely adults (greater than 18 years old). One of the units included in the research accepted pediatric patients, however the acuity of a pediatric patient requiring an indwelling urinary catheter would be uncommon for that unit, and the pediatric census in this hospital has historically been very low.

Results

CAUTI rates. CAUTI rates decreased from a mean of 1.63 per 1,000 catheter days in the year prior to implementation of the bundled interventions (October 1, 2015 to September 30, 2016) to 0.67 per 1,000 catheter days in the year following initiation of the CAUTI collaborative (December 1, 2016 to November 30, 2017) ($U = 24, p = .004$).

Furthermore, there was a 5% reduction in catheter days between the year prior to and the year following formal staff education. During the first year, there were a total of 9,526 catheter days for an average of 794 catheter days per month. During the second year, there were a total of 9,051 catheter days for an average of 754 catheter days per month.

Nursing staff compliance. Overall compliance with the bundle of interventions increased from 85% to 92%. It took approximately 1.4 months after nursing staff education and implementation of the CAUTI bundle to achieve 90% overall compliance, which was the benchmark designated by the hospital ($p < 0.05$). The estimated total compliance proportion increased steadily, peaking at 95% six months following the education and then dropped below 90% approximately 10.5 months after the education.

Discussion

CAUTI rates. Due to the abnormal distribution of the data as well as the number of months in which there were no CAUTIs, a t -test was not able to be utilized as initially intended for the analysis of CAUTI rates. Instead, a nonparametric analog, the Mann-Whitney U test, was used to compare CAUTI rates before and after the intervention. Rather than assuming the data follows a particular distribution, as the t -test does, the Mann-Whitney U ranks values. In doing so, this test determines whether two samples came from populations with the same underlying distribution. In this study, the test helped determine whether the true center of distribution was less than that of the baseline of 1.63 CAUTIs per 1,000 catheter days. A resulting p -value $< .05$ provides strong evidence that the CAUTI rates came from a population that did not have a center location of 1.63. In practical terms, the year following initiation of the bundled CAUTI interventions was associated with a statistically significant lower CAUTI rate. As the

sample was not randomized, it can only be said there was an association between the bundled interventions and CAUTI rates, and not a causation. Nonetheless, there was a significant reduction in CAUTI rates, which was the desired outcome. The national benchmark of 1.8 CAUTIs per 1,000 catheter days was far surpassed.

Additionally, the 5% reduction in catheter days is the start for success in reducing CAUTI rates. As one of the greatest risks for a CAUTI is the length of time an indwelling catheter is in place, reducing the catheter days alone should result in a reduction in CAUTI rates (Lo et al., 2014). In one study, the researchers were able to achieve a significant reduction in CAUTI rates simply by performing a daily assessment of ongoing indwelling urinary catheter need and discontinuing catheters not meeting an appropriate indication, thus reducing catheter days (Meddings et al., 2015).

While other studies have used varying interventions in their CAUTI prevention bundles, similar results have been achieved. Carr et al. (2017) and Marra et al. (2011) also noted a statistically significant reduction in CAUTI rates as well as a decrease in catheter days following implementation of a bundle of interventions. Another institution, similar in size and unit type to the one utilized in this study, updated their bundled interventions and experienced a reduction in CAUTI rates following staff education (Gokula et al., 2012).

Nursing staff compliance. Nursing staff compliance with the bundled interventions was explored using linear regression to review overall staff compliance with the bundled interventions for a period of time. Data was aggregated across the designated units and plotted for the months while the CAUTI collaborative was introduced and staff were educated (August 2016 through December 1, 2016) as well as

for the year following staff education (through November 2017). The resulting fitted regression line was able to provide an estimate for the time it took to achieve the benchmark compliance of 90% (1.4 months after the education), the time in which compliance peaked at 95% (6 months after the education), and the time it took for compliance to drop below 90% (10.5 months after the education). The linear regression line clearly shows compliance was not constant and was only able to be maintained above 90% for a nine-month period of time following nursing staff education. This suggests there is need for continuing education related to the bundle of interventions aimed at reducing CAUTI. Ideally, this should take place between the sixth and ninth month after initial education, which was the time during which compliance rates began to drop, but still remained above 90%.

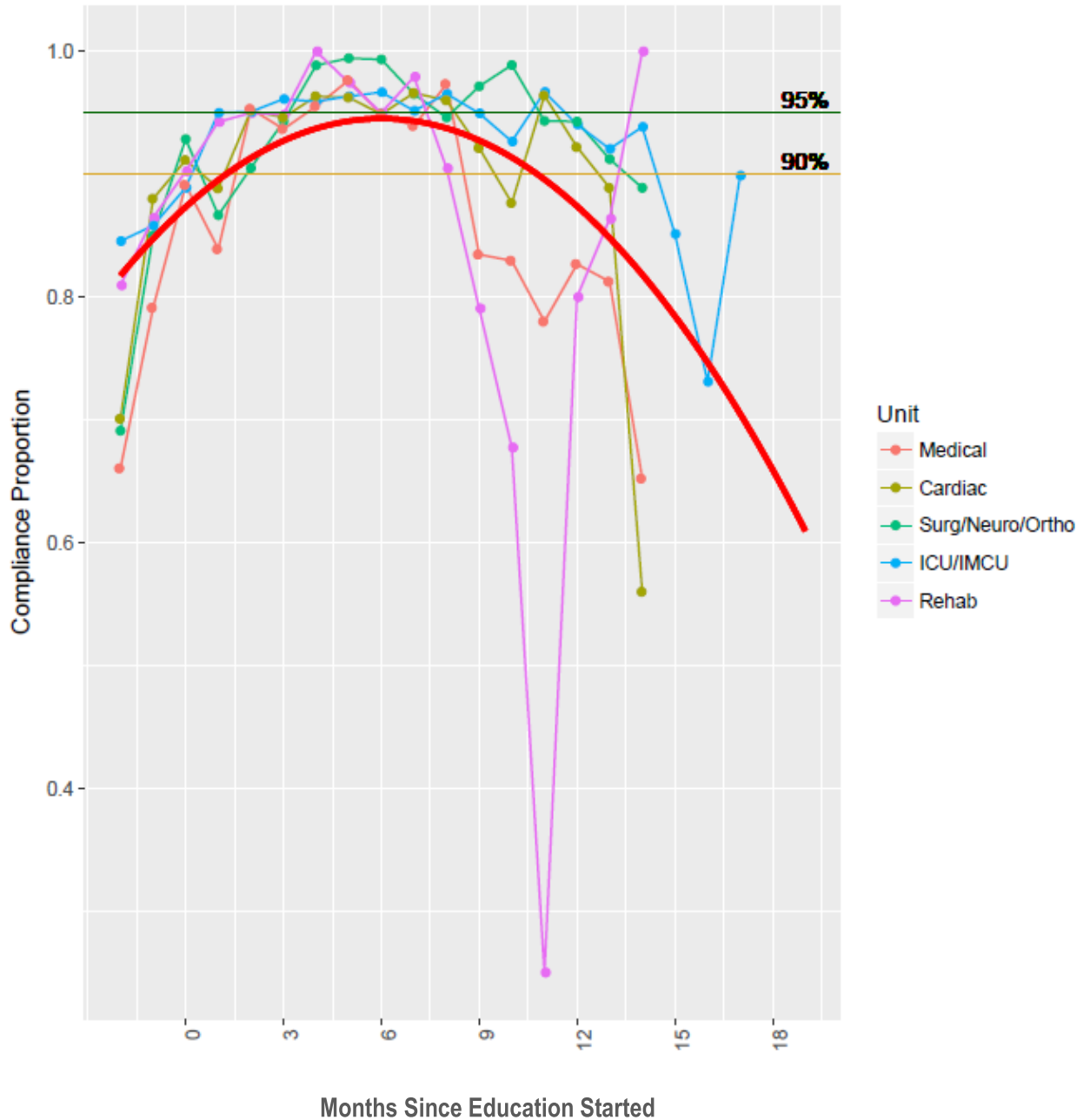


Figure 1. Total Nursing Staff Intervention Compliance Proportions by Unit from August 2016 to December 2017.

It is also important to note the reason for the outlying low mean compliance proportion for the physical rehabilitation unit approximately 10.5 months after the education. During this month, there was only one patient with an indwelling urinary

catheter in place, and compliance was only able to be assessed for four of the interventions at the time of device rounds. As compliance was met for one of the four interventions, a monthly average of 25% compliance resulted.

Furthermore, the mean intervention compliance proportions in the two months prior to and in the year following implementation of the CAUTI bundle were examined. These values were calculated by dividing the number of times staff were compliant with each of the 10 selected interventions by the total number of observations made. It is clear to see the mean compliance proportions did increase between the pre-intervention/intra-intervention period prior to and throughout the education sessions (August 2016 through the start of December 2016) and the post-intervention period in the year following the education sessions for all 10 of the CAUTI-prevention interventions (See Table 1).

Table 1

Mean Intervention Compliance for All Units

	Floor	Bladder	L/K	Seal	Sec.	CC	PC	Shift	Edu.	Need	Total
Pre	0.96	0.98	0.97	0.80	0.95	0.86	0.70	0.80	0.62	0.91	0.85
Post	0.99	1.00	1.00	0.96	0.96	0.95	0.88	0.91	0.73	0.98	0.92

Note. Pre = average compliance in the 2 months prior to staff education; Post = average compliance in the 12 months after staff education; Floor = bag off floor; Bladder = bag below level of bladder; L/K = no loops or kinks in tubing; Seal = seal between catheter and tubing remains intact; Sec. = catheter is secured to the leg with a securement device; CC = catheter care is completed daily; PC = perineal care is performed daily; Shift = catheter assessment is documented every shift; Edu. = CAUTI prevention education is printed and provided to the patient within 24 hours of catheter insertion; Need = ongoing need for the catheter is documented daily; Total = overall compliance with all the interventions.

While compliance was maintained at a high level, above 95%, both prior to and following education in some areas, there was a greater improvement in compliance rates in other areas. Nursing staff compliance with keeping the urinary drainage bag off the floor, maintaining the position of the bag below the level of the patient's bladder,

ensuring tubing remained free from loops and kinks, and securing the catheter to the patient's leg with a securement device was already above 95% prior to the formal education and remained above 95% following the education. Ensuring the seal remained intact between the urinary catheter and drainage tubing increased from 80% compliance to 96% compliance, an improvement of 16%. This is significant as breaking the seal to disconnect the catheter tubing from the drainage tubing allows for potential bacterial contamination and places the patient at increased risk for a CAUTI. Nursing staff compliance with performing daily indwelling urinary catheter care and documenting an assessment of the urinary catheter every shift improved by 11%, and daily documentation of ongoing need for the indwelling urinary catheter increased by 7%.

Despite a notable improvement and ability to reach the 90% compliance goal for a period of time, compliance was not able to be consistently maintained for two interventions. Daily perineal care increased from 70% compliance to 88% compliance, which is a significant improvement, but still falls short of the desired goal. This is interesting as 95% compliance was achieved with daily catheter care, and perineal care is an extension of catheter care. Because of the overlap in these two interventions, it may have simply been an issue where perineal care was completed along with catheter care, but only catheter care was documented. Nursing staff easily may have assumed that perineal care was included in catheter care, and only documented completion of catheter care. This is an area that should be explored further. Clarification may need to be made, explaining what constitutes perineal care and catheter care, along with the associated required documentation for each.

The other intervention that failed to maintain an average compliance above 90% was printing the CAUTI prevention education handout within 24 hours of catheter insertion. An 11% improvement was made for compliance with this intervention, but the average compliance remained low at 73%. When the written CAUTI education handout was printed, CAUTI education was automatically documented as completed in the patient's medical record. There was an underlying assumption that if the CAUTI education handout was printed patient education actually occurred, which may have not been the case. Similarly, when the education handout was not printed, this does not necessarily mean there was no patient education on CAUTI prevention provided. Education takes many forms, and nurses frequently educate patients verbally while providing routine daily care, such as assessing and caring for an indwelling urinary catheter. Education also often takes place verbally upon the initiation of an intervention, such as at the time an indwelling urinary catheter is inserted. This verbal education should be documented in the patient's EMR in an area designated for patient education. Because this area of the medical record was not reviewed to assess for compliance with CAUTI education, it may have actually been performed more frequently than it appears from the data. This is another area that requires follow-up and further exploration of alternate ways in which CAUTI prevention education may have been provided and documented. Nursing staff may also need further education emphasizing the desire to provide printed education along with the verbal education and a refresher on how this is done.

While assessing staff compliance with bundled interventions to reduce CAUTI is something mentioned in other studies, specific results are often lacking. Marra et al.

(2011) did note a compliance range from 42.5% to 99.6% following formal staff education, but did not have baseline data for comparison. To the best of this author's knowledge, this DNP scholarly project is the first to specifically evaluate nursing staff compliance with CAUTI prevention interventions prior to and following formal staff education. More importantly, compliance was trended overtime, providing insight into the need for ongoing staff education between six and nine months following initial education. Other authors make note of the need for consistent staff education, but timing for this education is lacking or not supported by any data. Carr et al. (2017) suggested weekly compliance audits and unit huddles to help promote sustained success. While this might be ideal, it may not be feasible considering available resources and other quality improvement projects taking place concurrently. Similarly, Giles et al. (2015) agrees with the importance of continuing staff education, compliance monitoring, and feedback systems, but provides no data suggesting an appropriate time parameter for these strategies to help sustain compliance.

Strengths and Limitations

There were numerous strengths identified throughout this DNP scholarly project. To begin with, there was consistency in the way nursing staff were educated about the use of the 10 bundled interventions to reduce CAUTIs. Trained educators provided education to all staff in the same manner, utilizing the same poster to guide the script. As the education was included in a mandatory Harms Prevention event for all nursing staff, there was assurance that all staff received the information. Furthermore, information on all of the preventable harms was added to new-hire orientation following the Harms Prevention event. This assured any new staff were made aware of the bundled

interventions and plan for assessing compliance. One group that may have received limited education was the travel nurses. The hospital utilized some travel nurses during the time the study took place, and their orientation period was more abbreviated than typical new hires.

The data collection process was another strength of this DNP scholarly project. Data was collected systematically using a standardized form and following a set rotation schedule. Only two individuals, the hospital's Infection Preventionist and a trained auditor, were involved in data collection, further ensuring consistency. Data collected on paper was entered into an electronic database at a minimum of every week by a single individual, the Infection Preventionist. The data was clearly labeled and organized, allowing for easy use retrospectively.

While a convenience sample was utilized and there was no randomization of the sample, all patients on the designated units with an indwelling urinary catheter in place were included in the review of CAUTI rates prior to and following initiation of the bundled interventions. Because the entire population was utilized, results can be generalized to all patients with indwelling urinary catheters on similar units within this hospital. Likewise, a convenience sample without randomization was utilized when reviewing staff compliance rates with interventions to prevent CAUTIs. However, because every patient with an indwelling catheter in place during device rounds was included in the data, the results are still likely to be generalizable. No patients were purposefully excluded from the data. At random, some patients were unavailable and not able to be included in all portions of data collection. For example, if a patient happened to be off the unit at the time of device rounds, or was involved in a procedure on the unit,

direct patient observation was not able to be made. In these occurrences, the EMR was still able to be reviewed for compliance with five of the 10 interventions.

A limitation of this research was the retrospective design. Had this study been planned out prior to implementation of the bundled interventions to reduce CAUTI, there would have been some modifications made to improve the strength of the results. First, there potentially could have been a longer period of time for collection of baseline data related to nursing staff compliance with the 10 bundled CAUTI-prevention interventions. Data collection actually began after inception of the CAUTI collaborative and selection of the bundled interventions. Because members of the CAUTI collaborative included direct patient care staff as well as Nurse Managers and Clinical Educators who were in regular contact with nursing staff, informal discussion of the bundle of interventions may have been discussed prior to the formal staff education dates. As a result, nursing staff may have already been ensuring implementation of some of the bundled interventions during the time baseline data was being collected. Consequentially, there may have actually been a greater increase in compliance than was suggested in the data. Additionally, because staff education took place over a two-month period, there was not a single date between the pre-intervention period and post-intervention period. Data collected during the months of October, November, and the start of December, 2016 contained a mix of staff who completed the education and staff who had not yet completed it, so this must be taken into consideration. Furthermore, the data collection instrument had not previously been utilized, and therefore had not been tested for reliability or validity. That being said, the tool and its use was described in detail and a copy was also included in Appendix E. To the knowledge of this author, no similar

published research contained such a detailed description of the data collection instrument and process.

The time at which device rounds took place may have served as a limitation, as nursing staff compliance could have varied between shifts. Because device rounds occurred during the day shift and start of the evening shift, direct patient observation for nursing staff compliance with certain interventions only took into account staff working at these times. Interventions such as keeping the urinary drainage bag off the floor, positioning of the urinary drainage bag below the level of the patient's bladder, keeping the tubing free from kinks and loops, and ensuring securement of the catheter tubing to the leg were only assessed during the designated rounding times. Compliance rates may have differed later in the evening or overnight for these interventions. Similarly, because device rounds only took place Monday through Friday, staff compliance over the weekend was not taken into consideration. If staff compliance on the weekends varied greatly from staff compliance during the weekdays, this could also alter the data. Because the EMR review took into account documentation completed in the past 24-hours, the timing of device rounds did not impact the following interventions: indwelling urinary catheter care is completed daily, perineal care is performed daily, indwelling urinary catheter assessment is documented every shift, ongoing need for the indwelling urinary catheter is documented daily, and the CAUTI prevention education handout is printed and provided to the patient within 24 hours of catheter insertion.

A potential limitation of any study involving EMR review is the question of accuracy of the information. There is the potential that nursing staff documented an

intervention was performed when, in fact, it was not. Similarly, an intervention may have been performed but not documented.

Recommendations for Future Research

One of the greatest limitations in current literature related to CAUTI prevention is the lack of a standardized bundle of interventions. Because each study reviews the use of a different set of interventions, there is no specific bundle determined to be most effective in reducing CAUTI rates. It would be beneficial to review the success of a standardized bundle implemented in a variety of settings. Also lacking in the research is detailed evaluation of staff compliance with CAUTI prevention interventions. This author was unable to locate a single study that trended compliance over time. This is important as it provides valuable insight into when ongoing staff education related to the bundled interventions should occur.

Based on the preexisting data utilized for this research, further exploration of CAUTI rates and nursing staff compliance broken down for each individual unit could occur. This would identify if any particular unit was failing to meet benchmarks and education could be customized accordingly to meet the needs of that unit. If this same study was to be conducted in an institution that has yet to implement a bundle of interventions to reduce CAUTI, it is recommended a prospective design be utilized. As opposed to a retrospective design, a prospective design would allow for randomization of subjects as well as increase knowledge of potential confounding variables. To help improve retention of the information and provide a quick resource for nursing staff, a card listing the bundled interventions could be provided during the education session. This information could also be emailed to nursing staff and posted on each unit for easy

reference. Additionally, data collection should occur on all shifts instead of just on day and the start of evening shift. In doing so, compliance data could be separated by shift to identify any shift-related differences in compliance proportions. Finally, a more specific and accurate way to determine if CAUTI prevention education was provided to each patient should be identified.

Conclusion

CAUTIs remain a preventable patient harm. Despite this fact, CAUTI rates exceed the national benchmark and continue to contribute to patient discomfort, complications, prolonged hospital stays, rising healthcare costs, and increased mortality. Evidence-based guidelines propose a bundle method is the most effective way to successfully reduce CAUTIs. However, no standardized bundle of interventions exists; each healthcare institution is directed to select interventions based on the CAUTI prevention strategies already in use and add additional interventions as needed based on their institutional needs.

This Doctor of Nursing Practice (DNP) scholarly project utilized a retrospective pretest-posttest design to explore the effectiveness of a bundle of interventions in reducing CAUTI rates at a rural Midwestern hospital. Additionally, nursing staff compliance with the bundled interventions following formal education was examined. In the year following implementation of the bundled interventions, CAUTI rates decreased from a mean of 1.63 to 0.67 per 1,000 catheter days. There was also a 5% reduction in catheter days in the year following formal staff education when compared to the previous year. Additionally, nursing staff compliance increased steadily in the six months following staff education, with total compliance for all units exceeding 95%.

This study added to the body of nursing knowledge by being the first to measure nursing staff compliance with bundled CAUTI prevention interventions over a long period of time. Future research exploring the effectiveness of a standardized bundle of interventions for reducing CAUTIs implemented in a variety of settings is recommended.

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Appendix A

CAUTI Education for Patients

FAQs

(frequently asked questions)

about “Catheter-Associated Urinary Tract Infection”

What is “catheter-associated urinary tract infection”?

A urinary tract infection (also called “UTI”) is an infection in the urinary system, which includes the bladder (which stores the urine) and the kidneys (which filter the blood to make urine). Germs (for example, bacteria or yeasts) do not normally live in these areas; but if germs are introduced, an infection can occur.

If you have a urinary catheter, germs can travel along the catheter and cause an infection in your bladder or your kidney; in that case it is called a catheter-associated urinary tract infection (or “CA-UTI”).

What is a urinary catheter?

A urinary catheter is a thin tube placed in the bladder to drain urine. Urine drains through the tube into a bag that collects the urine. A urinary catheter may be used:

- If you are not able to urinate on your own
- To measure the amount of urine that you make, for example, during intensive care
- During and after some types of surgery
- During some tests of the kidneys and bladder

People with urinary catheters have a much higher chance of getting a urinary tract infection than people who don’t have a catheter.

How do I get a catheter-associated urinary tract infection (CA-UTI)?

If germs enter the urinary tract, they may cause an infection. Many of the germs that cause a catheter-associated urinary tract infection are common germs found in your intestines that do not usually cause an infection there. Germs can enter the urinary tract when the catheter is being put in or while the catheter remains in the bladder.

What are the symptoms of a urinary tract infection?

Some of the common symptoms of a urinary tract infection are:

- Burning or pain in the lower abdomen (that is, below the stomach)
- Fever
- Bloody urine may be a sign of infection, but is also caused by other problems
- Burning during urination or an increase in the frequency of urination after the catheter is removed.

Sometimes people with catheter-associated urinary tract infections do not have these symptoms of infection.

Can catheter-associated urinary tract infections be treated?

Yes, most catheter-associated urinary tract infections can be treated with antibiotics and removal or change of the catheter. Your doctor will determine which antibiotic is best for you.

What are some of the things that hospitals are doing to prevent catheter-associated urinary tract infections?

To prevent urinary tract infections, doctors and nurses take the following actions.

Catheter insertion

- o Catheters are put in only when necessary and they are removed as soon as possible.
- o Only properly trained persons insert catheters using sterile (“clean”) technique.
- o The skin in the area where the catheter will be inserted is cleaned before inserting the catheter.
- o Other methods to drain the urine are sometimes used, such as
- External catheters in men (these look like condoms and are placed over the penis rather than into the penis)
- Putting a temporary catheter in to drain the urine and removing it right away. This is called intermittent urethral catheterization.

Catheter care

- o Healthcare providers clean their hands by washing them with soap and water or using an alcohol-based hand rub before and after touching your catheter.

If you do not see your providers clean their hands, please ask them to do so.

- o Avoid disconnecting the catheter and drain tube. This helps to prevent germs from getting into the catheter tube.
- o The catheter is secured to the leg to prevent pulling on the catheter.
- o Avoid twisting or kinking the catheter.
- o Keep the bag lower than the bladder to prevent urine from backflowing to the bladder.
- o Empty the bag regularly. The drainage spout should not touch anything while emptying the bag.

What can I do to help prevent catheter-associated urinary tract infections if I have a catheter?

- Always clean your hands before and after doing catheter care.
- Always keep your urine bag below the level of your bladder.
- Do not tug or pull on the tubing.
- Do not twist or kink the catheter tubing.
- Ask your healthcare provider each day if you still need the catheter.

What do I need to do when I go home from the hospital?

- If you will be going home with a catheter, your doctor or nurse should explain everything you need to know about taking care of the catheter. Make sure you understand how to care for it before you leave the hospital.
- If you develop any of the symptoms of a urinary tract infection, such as burning or pain in the lower abdomen, fever, or an increase in the frequency of urination, contact your doctor or nurse immediately.
- Before you go home, make sure you know who to contact if you have questions or problems after you get home.

If you have questions, please ask your doctor or nurse.

Co-sponsored by:



Appendix B

Hospital IRB Approval



March 14, 2018

Natalie Pianetto Buck, RN
571 Silver Creek Road
Marquette, MI 49855

RE: Reduction of Catheter Associated Urinary Tract Infections through a
Nurse-Led Collaborative

Study approval period: March 14, 2018 to February 14, 2019

Dr. Ms. Pianetto Buck

Review of the above-referenced study by the UP Health-System Marquette's (UPHS-M) Institutional Review Board (IRB) was completed at the March 14, 2018 meeting. I am pleased to advise you that the rights and welfare of the human subjects appear to be adequately protected and the IRB has approved this study for a period of one year. Documentation specifically reviewed was the following:

- Retrospective Data Collection Study Form

You are reminded that the next Board approval for this study will be set for one calendar year (date indicated above) or upon completion of the project-whichever comes first. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate IRB approval prior to February 14, 2019. If this study is completed before one year, notification of completion and results need to be sent to the IRB for review. Any changes in procedures involving human subjects must be reviewed by the IRB prior to initiation of the change. The IRB must also be notified promptly of any problems (unexpected side effects, complaints etc.) involving human subjects during the course of this study.

Thank you for bringing this project to our attention and we look forward to working with you in the future.

Sincerely,

Rudy Evonich, MD Chairman
Institutional Review Board UPHS-M
IRB #001757

ER/ssh

Appendix C

University IRB Exemption



Natalie Buck <nabuck@nmu.edu>

NMU IRB

Derek Anderson <dereande@nmu.edu>

Thu, Mar 15, 2018 at 12:32 PM

To: Kristi Robinia <krobinia@nmu.edu>

Cc: Janelle Taylor <jantaylo@nmu.edu>, Natalie Buck <nabuck@nmu.edu>, Lisa Flood <lflood@nmu.edu>

Hi All,

This project does not officially require IRB approval. If you need documentation for a grant or other outside compliance, let us know, and we can draft something. Otherwise, good luck moving forward with your project.

Best,

Derek

On Thu, Mar 15, 2018 at 11:43 AM, Kristi Robinia <krobinia@nmu.edu> wrote:

Hello Derek and Janelle:

I am forwarding an IRB proposal (seeking administrative approval) from DNP student Natalie Buck and her Chair Lisa Flood. Thank you for your consideration of this research request; she has already obtained UPHS-Marquette IRB approval to use their data,

Sincerely,

Kristi Robinia
Associate Dean/Director
School of Nursing

Appendix E

UPHSM Indwelling Device Rounding Tool

UPHSM INDWELLING DEVICE ROUNDING TOOL			
Today's date:		If asked not to enter, reason given:	
Permission to enter room provided by:		Account #	
Last Name:	Room:	Admit date:	
CVC 1:		Start date:	Indication:
Y N Dressing clean	Y N Green Curo's cap on all hubs		Y N CHG bath given
Y N Dressing dry	Y N Needleless connector is clean		Y N CLABSI education given
Y N Dressing intact	Y N Tubing is not back capped	Y N Lumens flushed with 10ml NS Q8	Y N Line indication known
Y N Dressing dated & initialed	Y N Tubing is dated	Y N Line assessed Q12	Y N Line is still indicated
Y N Dressing Δ not overdue	Y N Tubing Δ not overdue		
Comments:			
CVC 2:		Start date:	Indication:
Y N Dressing clean	Y N Green Curo's cap on all hubs		Y N CHG bath given
Y N Dressing dry	Y N Needleless connector is clean		Y N CLABSI education given
Y N Dressing intact	Y N Tubing is not back capped	Y N Line assessed Q12	Y N Line indication known
Y N Dressing dated & initialed	Y N Tubing is dated		Y N Line is still indicated
Y N Dressing Δ not overdue	Y N Tubing Δ not overdue		
Comments:			
Foley		Start date:	Indication:
Y N Bag off floor	Y N Securement device in place		Y N CAUTI education given
Y N Bag below bladder	Y N Foley care 1x day		Y N Line indication known
Y N Tubing not loop/kinked	Y N meatal/pericare 1x day		Y N Line is still indicated
Y N n/a Seal intact	Y N Foley assessed Q12		
Comments:			
VENT			
Y N HOB 30-45 degrees	Y N Early ambulation		Y N CHG bath given
Y N Oral Care Q 4 hrs	Y N n/a sterile single-use cath for open LR suction		Y N VAP education received
Y N CHG mouthwash Q4 (MAR)	Y N Yankuer clean and secure		
Comments:			
Unit leader acknowledgement _____			
Planned Actions: _____			

Appendix F

Permission to Include UPHSM Indwelling Device Rounding Tool



Natalie Buck <nabuck@nmu.edu>

Data for thesis

Kilroy Amy <Amy.Kilroy@mghs.org>
 To: Natalie Buck <nabuck@nmu.edu>

Wed, Jun 13, 2018 at 3:35 PM

Sure!

Just had to check with the boss and she said that was fine

Amy Kilroy, MPH CIC
 Infection Preventionist



Marquette, MI 49855
 Office: 906-225-3689
 Cell: 517-775-4399

From: Natalie Buck [mailto:nabuck@nmu.edu]
Sent: Wednesday, June 13, 2018 11:50 AM
To: Kilroy Amy <Amy.Kilroy@mghs.org>
Subject: Re: [EXTERNAL] Re: Data for thesis

Amy,

Thank you so much for the information and UPHSM Indwelling Device Rounding Tool. Do I have your permission to include a copy of this tool in the Appendix of my paper?

Natalie